Manual for the
Silent R 1,61m V2
Automatic-variable-pitch propeller

V2 2-Blade suitable for Jabiru 2200.

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This propeller is designed for experimental and ultralight aircraft. The propeller has to be approved on every single aircraft by the admission office of the relating country.

1.2 Propeller Description

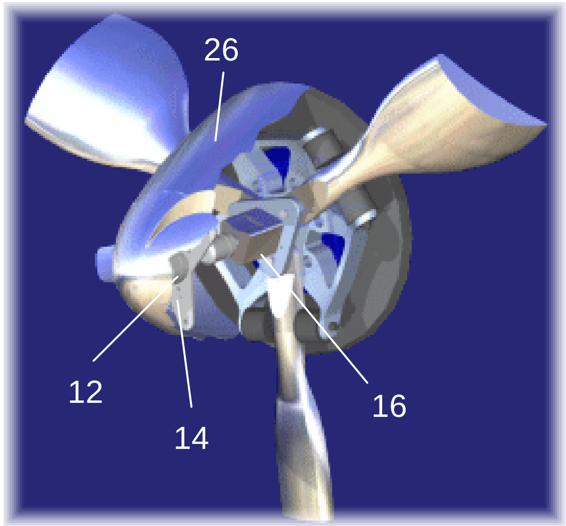
The variable pitch propeller “Silent R 1,61 V 3“ has been designed manufactured and tested by Silence-Aircraft GmbH in Germany.

The propeller hub is milled from aluminum alloy. The shape of the hub is optimized by computer-aided design. The Propeller blades are constructed from carbon fibre and are attached to the hub by a ball and socket joint with vibration dampers. These vibration dampers are to decrease the instantaneous starting torque moment to the propeller blades allowing the weight of the propeller blades to be reduced and get better durability.

The propeller pitch adjustment is automatically controlled and due to the design, there are no high maintenance controls from the cockpit to the propeller hub. Blade pitch adjustment is achieved via a generator which is rotated by an anemometer (vaned spinner) which is the front part of the propeller hub. This generator, which is installed behind the vaned spinner, registers the anemometer’s rpm and consequently the airspeed of the aircraft. This information is analysed by an electronic control unit and compared to pre-programmed flight characteristics of the aircraft. An electronic microprocessor controls a motor driven linear pitch change actuator and changes the propeller pitch via a linkage in accordance with programmed characteristics
These characteristics of the propeller can be individually adapted on the needs of the pilot and the speed range of the airplane. By changing the appropriate solder joints within the control unit the possibility exists to select from 16 different profiles. The maximum range of the pitch change adjustment is mechanically limited so that, with a loss of electronic control, the propeller maintains a safe pitch angle.

1.3 Construction of the propeller

Adjustment of the propeller pitch is controlled by the rotational speed of the spinner. With increasing airspeed the number of revolutions of this "vaned spinner" increases, which is designed so that it turns in the opposite direction to the propeller’s direction of rotation. This adds the rpm of the vaned spinner and the engine opposite direction of rotation. The spinner is mounted on the generator axle (12), which is fastened to the rear spinner cap (26). This generator produces the necessary adjustment power to the actuator and also serves as a frequency transmitter (tachogenerator) to the control unit. Within the electronic control unit (14) the frequency produced by the generator is evaluated and converted into an appropriate adjusting signal and via the linear actuator adjusts the propeller pitch. The programming of a microprocessor in the control unit makes it possible to simply adjust the characteristics of the propeller, engine and airplane.
The signal output of electronic control unit is assessed and transmitted to the linear actuator. The rotary motion of this pitch change motor is changed from rotary to linear by a linkage mechanism.
After each landing the propeller is automatically driven into full fine pitch and this minimum pitch is used as a reference point. This reference point ensures that an accurate start point for the blade pitch angle is achieved for each flight. Via a pitch change linkage the course pitch is mechanically limited so that if the propeller control fails the “Fail safe” characteristics of the propeller are achieved by limiting the course blade pitch, therefore always ensuring that the propeller can always be operated within a safe range.



Operation:

Take off: The throttle initially controls the propeller rpm so that when full power is selected the propeller rpm will be 2800 rpm. At this rpm the propeller will be in fully fine pitch. As the aircraft accelerates the airflow over the vaned spinner rises and causes the spinner to rotate. Even before take off speed the vaned spinner rpm is sufficient to ensure blade pitch control is achieved. As the climb speed increases the vaned spinner rpm increases and this is sensed by the electronic control unit and the blade pitch at the propeller blades is increased. The propeller torque and the engine rpm are limited by the increase of the blade pitch. The blade pitch increases with increasing speed, until the pitch stop for the "Fail Safe" criteria is reached. With further increase of the airspeed, as the blade rpm increases so will the engine rpm which unless monitored could cause the maximum engine rpm to be exceeded as the air speed increases

Cruise: During the cruise the throttle is reduced to a max continuous power setting as specified by the engine manufacturer. By reducing the engine rpm to for example 3000 to 2700 rpm the difference between the vaned spinner rpm and the propeller rpm causes the pitch to be reduced slightly this reduced the torque required from the engine thus saving engine wear and life.

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Landing: During the approach to land the throttle is fully closed. The propeller rpm is also reduced (e.g. 900 1/min), the influence of the lower rpm and speed this has a large effect on the input to the control unit. Due to the relative difference of rpms increasing the blade pitch is reduced to fully fine, this in course through “wind milling “ causes the engine rpm to increase, this energy is then dissipated through friction and engine compression losses, this effect causes the propeller to act as an aerodynamic brake and helps to reduce the landing distance required, this braking effect is very desirable.

The propeller blades are accurately balanced in the factory. Due to the lightness of the blades they have small moment of inertia around the axis of rotation, this allows a vibration free operation of engine

and propeller, and as small bending moments in the propeller hub as possible.

The following diagram shows the complete variable-pitch propeller with a cut open crank cap (26) and vaned spinner (10). The alloy hub (22), is fastened by six M8 screws (46) to the propeller flange. Inside the rear spinner the propeller blades are attached via the universal ball joint by allen headed bolts to the propeller hub and a second cover plate (40). The rear spinner (26) is fastened to the carbon fibre back plate (42). The six anti vibration absorbers protect the blade from any rotational shock loads. The pitch change linear drive motor is attached to the cover plate (40). The generator and electronic control unit (14) are attached to the generator mounting plate (44).

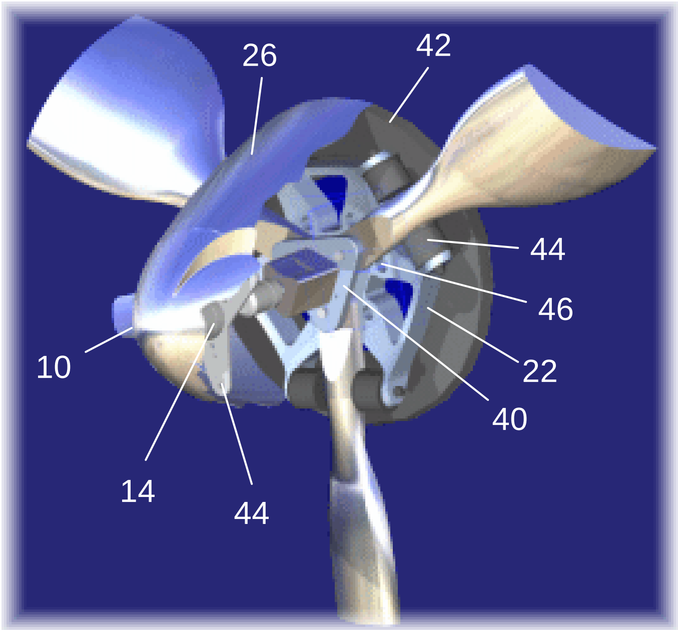


Fig. 1.3.2 Cut out view of the variable-pitch propeller

1.4 Name of the propeller

Silent R 1,61m V 3

Aircraft

Direction of rotation (As seen from the rear on the propeller)

Diameter (in Meters)

Pitch control (V= Variabel)

Number of blades

2. Operation limits

2.1 Application range of the propeller

The propeller was designed for use on experimental, kit and ultralight aircraft. For use in other countries than Germany permission and clearance must be sort from the appropriate design and Aviation authorities before use.

2.2 RPM limits

The propeller was developed for use with the Jabiru four and six cylinder four stroke engine. The propeller diameter has been designed to give optimal engine climb performance, economical cruise power output. Because of this a higher maximum cruise speed can be achieved. The following rpm figures are appropriate for the various flight stages:

Maximum rpm:	3300 rpm
Cruise rpm:	2750 rpm
Climb rpm:	2800-3000 rpm

2.3 Temperature limits. During operation in extreme ambient temperatures of over 35°C and under 10°C shorter servicing intervals are necessary. This also applies to operation with high humidity and in the proximity to seawater

2.4 Technical Data

Maximum airspeed:	300 km/h
Maximum acceleration:	+8g/-5g
Optimum flight altitudes:	0-15,000 feet
Flight in Icing conditions:	Not permitted
Flight in Rain :	Protect blades with 3M Tape
Weight of 2 bladed propeller:	5,5 kg
Weight 3 bladed propeller:	6,5 kg
Moment of interia 2 bladed propeller:	0,11kgm²
Moment of interia 3 bladed propeller:	0,16 kgm²

3. Emergency procedures

3.1 High Rpm

If after engine starting or a climb the propeller rotates with a too high rpm, then reduce the power the flight must be continued with a maximum of 3150 rpm. After landing an inspection of the propeller must be completed before the next flight.

3.2 Low RPM

If after a cruise the propeller does not return to fine pitch then cruise at a high speed until the descent to land to prevent the engine working at a high torque setting at slow speed, which could increase engine wear, and overheating. After the landing an inspection of the propeller is to be completed before the next flight.

3.3 High propeller vibration

The propeller is balanced at the factory but when it is fitted to the engine vibration might be experienced. The dynamic balancing of the propeller with the current engine is optimal. If during the flight unusually strong vibrations occur or a change of the vibrations is noticed, then the engine must be throttled back to as low a rpm as possible and a precautionary landing must be completed at the nearest suitable airport. After the landing an inspection of the propeller must be completed before the next flight.

4. Normal procedures

4.1 Checks at the engine run up point

If before take off the propeller is not in fully fine pitch (i.e. engine runs with full power with reduced rpm), then the following procedure must be accomplished:

1. Ensure engine temperatures within limits
2. Ensure parking brake set
3. Select full power and ensure take off rpm is achieved and the engine temperatures and pressures are within limits
4. Carry out take off checklist from the flight manual

4.2 Takeoff/climb/cruise/landing

The propeller pitch changes automatically with the change of airspeed (during constant throttle position).
During the take off and climb the throttle should be selected to give the optimal propeller rpm of 2800-3000 rpm.
For the cruise the engine rpm is lowered. Depending upon desire can be snapped the engine number of revolutions for or selected efficient cruising. A change of the characteristic is to be accomplished after the instructions in chapter 5.7.
For the landing the pitch of the propeller is reduced, so that the propeller produces a relatively high rpm and thus an aerodynamic braking effect. Therefore landings with shorter landing distance can be accomplished.

5. Installation

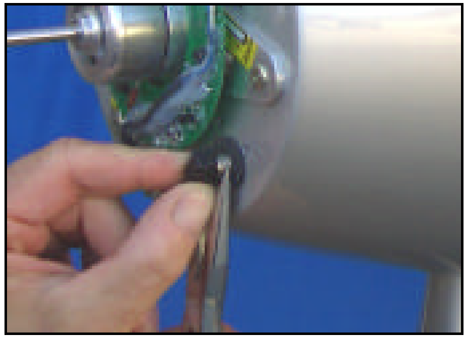
5.1 Removing the Spinner cap

1. To remove the vaned spinner use a 2mm allen key to loose the grub screw via the hole in the spinner cap (see fig.4.1.1) the screw loosens in a clockwise direction
2. Remove the vaned spinner

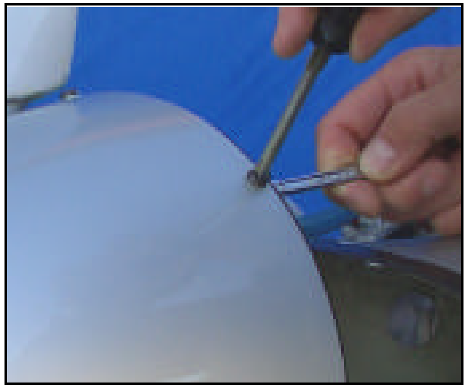
Remove screw
with 2,5 mm
allen key

Abb. 4.1.1

3. With the vaned spinner removed loosen and remove the connecter plug with the aid of a pair of sharp point pliers. (Caution the black part of the connecter plug must be held, otherwise if rotation is allowed a risk of damaging the rear gold contacts)



4. Remove the rear spinner from the carbon-fibre back plate.



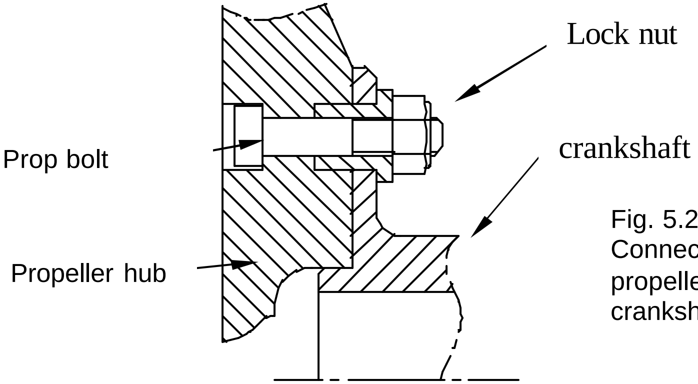


Fig. 5.2.1
Connection of the propeller hub to the crankshaft

5.2 Attaching the propeller to the crankshaft

The propeller is to the crankshaft via the eight M8 bolts and lock nuts with the 5mm Allen key in accordance with Fig 5.2.1. Before attaching the propeller both attachment faces must be cleaned with an appropriate solvent. With the Allen key the screws are held against twisting (note: The blade root is very close to the allen key take care not to damage the blade root). The nuts must be tightened with a torque loading of 23 Nm

5.3 Checking and adjusting the blade track

The blade track can calibrated by using a block, which is put on the ground, or by a device, which is fastened to the engine cowling. (see Fig. 5.3.1). The deviation should not be larger at the blade tip than +/-1,5mm.The blade track can be corrected by adjusting the vibration absorbers (see fig 5.5.3)

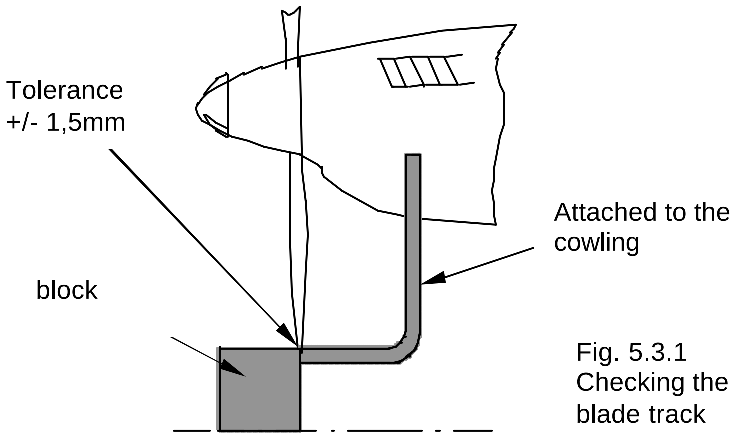


Fig. 5.3.1
Checking the blade track

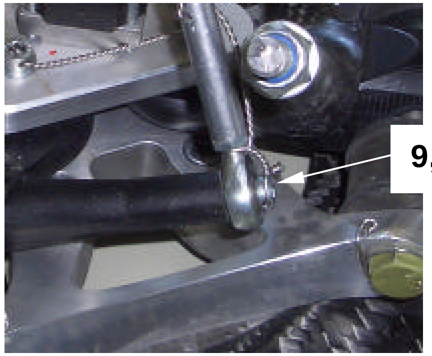


Fig 5.4.1
Torque loading the pitch change arm bolt

5.3 Checking and adjusting the propeller blade pitch

The adjustment of the propeller blade pitch can be achieved by accomplishing the following procedure:

1. Remove the locking wire on the pitch change arm.
2. Remove the pitch change arm bolt
3. Loosen the lock nut on the pitch change arm eye end
4. Turn the pitch change eye end in the desired direction
5. Check the adjusted blade pitch and the pitch of the other blade are with in +/- 0.5° of each other
6. Tighten and check torque load the pitch change arm bolt (torque 9,5Nm see Fig. 5.4.1
7. Replace the locking wire (see fig 5.5.6)

5.5 Torque loading of the attachment bolts

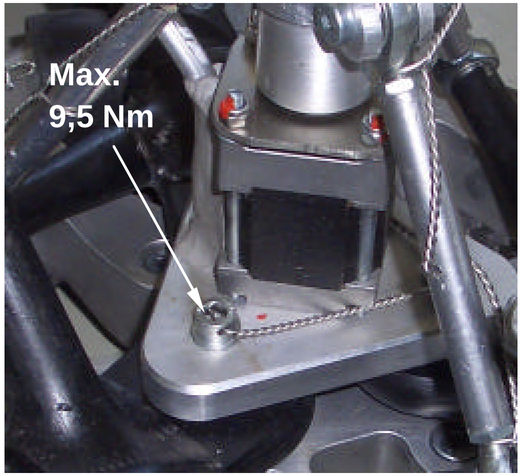


Fig. 5.5.1 Torque loading the propeller main attachment bolt

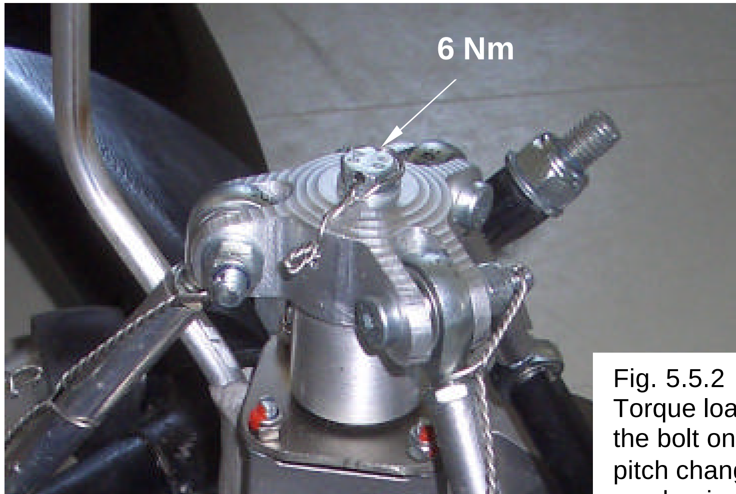


Fig. 5.5.2 Torque loading the bolt on the pitch change mechanism

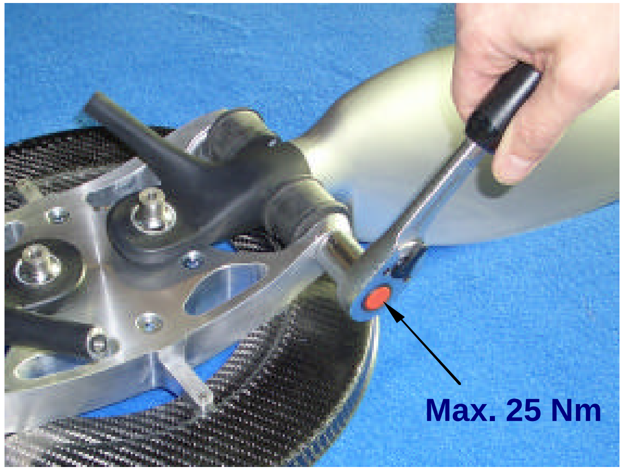


Fig. 5.5.3
Torque loading the vibration damper bolts

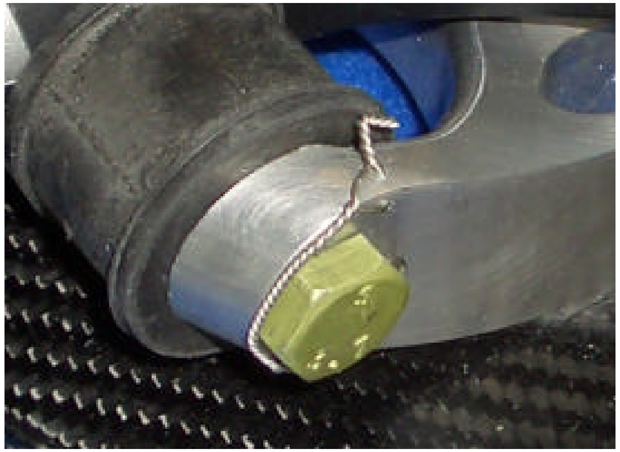


Fig 5.5.4 Wire locking the vibration damper bolt

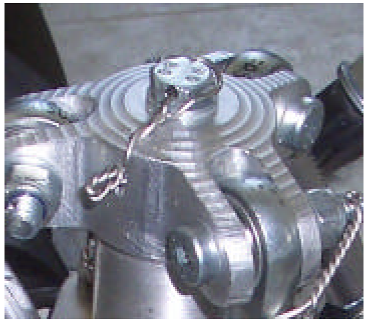


Fig. 5.5.5
Wire locking the M6 screw on the pitch change mechanism

Fig. 5.5.6 Wire locking the pitch change arm bolt

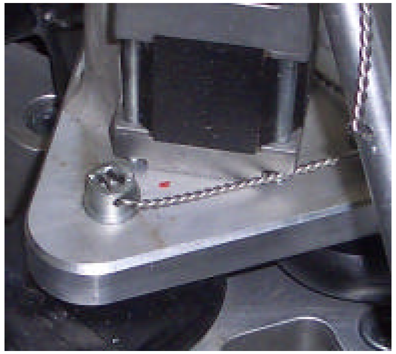


Fig. 5.5.7 Wire locking the propeller attachment bolts

5.6 Assembly of the spinner

The assembly of the spinner is the reverse order of the disassembly in section 5.1. The grub screw in the vaned spinner is tightened with a 2mm Allen key

5.7 Adjusting the electronic control settings

16 different characteristics can be selected by a combination of four solder points that are found on the generator mounting plate beneath the vaned spinner (see fig 5.7.1). If the solder joints are changed make sure that any excess solder does not damage the other solder joints or heat it is advised that temperature controlled soldering irons are only used. Surplus tin solder must be carefully removed with a solder strip or a suction pump. The current propeller characteristics are attached as separate sheet in table form and as a diagram. In the table "0" characterized bridges may not be bridged, "X" characterized bridges must be bridged with tin solder.

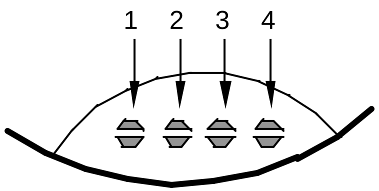


Fig 5.7.1. Solder points on the generator mounting plate

5.8 Reassembling the Spinner

The assembly of the spinner takes place in reverse order of the disassembly in section 5.1.

6. Checks and maintenance

The propeller is maintenance-free. (lubrication is not required!) The inspections serve for inspection of the individual propeller components.

6.1 Daily inspection

- Check vaned spinner for contamination and smooth rotation
- Check the rear spinner for condition and damage
- Blades for condition and play
- Check the shock absorbers for correct lag and lead damping
- Check the rear spinner screws are tight and secure

6.2 5, 50, 100 and 250 hours of inspection

Disassemble the spinner in accordance with section 5.1

- Examine all bolt connections.
- Check torque load the propeller flange and crankshaft bolts after the first 5 hours and after then every 50 hours
- Examine the locking wire for looseness and chafing
- Examine the propeller hub for any cracks and damage (visual inspection)
- Examine the spinner caps for any cracks and delamination (visual inspection)
- Examine the generator for smoothness of operation and condition

Maintenance inspection sheet

Number	Inspection [h]	Test date	Name	Signature
1	5			
2	50			
3	100			
4	150			
5	250			
6	350			
7	500			
8	750			
9	1000			
10	1250			
11	1500			
12	1750			
13	2000			

6.3 Annual check

Disassemble the spinner in accordance with section 5.1

- Examine all bolt connections.
- Check torque load the propeller flange and crankshaft bolts after the first 5 hours and after then every 50 hours
- Examine the locking wire for looseness and chafing
- Examine the propeller hub for any cracks and damage (visual inspection)
- Examine the spinner caps for any cracks and delamination (visual inspection)
- Examine the generator for smoothness of operation and condition

6.4 Extreme climatic conditions

Extreme climatic conditions can lead to shorter servicing intervals. If doubts exist with the use of the propeller, then this is to be agreed upon with the manufacturer.

6.5 Cleaning

The propeller must be only cleaned with a moist cloth; use of a wet cloth is discouraged. Excessive contamination of the propeller blades, e.g. by insects, leads to a decrease in propeller efficiency and can cause vibration. It is advised to protect the propeller after flying from accidental damage from passers by that the propeller blades are fitted with protective covers.

6.6 Repair

Repair work is to be agreed upon in each case with the manufacturer.
The manufacturer can not guarantee for modifications to the propeller and the spinner, because these modifications are not tested!

7. Dispatch

The use of the original shipping packaging is the best method of transporting the propeller. If other packaging is used ensure the propeller leading edges are protected. In addition the rib hood must be supported. The container must be completely lined with supporting materials, so that the propeller is securely fixed in the package.

8. Painting

After painting the rib cap it has to send back to the manufacturer for balancing!